KNOWLEDGE
AN ILLUSTRATED
MAGAZINE OF SCIENCE
PLAINLY WORDED—EXACTLY DESCRIBED

LONDON: FRIDAY, JANUARY 19, 1883.

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Science and Art Gossip.

I SCARCE ever lecture for a week without some new experience, though I have lectured so long and so often. Last week I had two entirely new experiences. I unwillingly came near upsetting a Mayor (never mind where), and not less unwillingly came near being upset by a lantern. The first was on this wise:—There being but one seat on the platform, and the chairman having begun to address the audience, I remarked to him that till he had got through I would borrow "the chair;" but in the full flow of his eloquence he heard me not; so when he had done, deeming the chair still behind him, he prepared to sit where no seat was. Luckily he heard my warning voice just in time. The fall of the lantern occurred the following night. I caught the lantern twice, first on my shoulder (where I did not want it), then in my arms, as it was on its way, after glancing from my shoulder, to the floor below the platform, where it must inevitably have been destroyed. It worked pretty well after this, but I think in future I shall look more cheerfully at a lantern on a floor or in an opposite gallery than when set where it may fall on the lecturer. I am a fairly good "catch" at cricket (my boys think), but I have not had much practice catching oxyhydrogen lanterns.

"THE stars in their courses," we are told, "fought against Sisera." We are by no means clear as to the method adopted by the astral belligerents; but perhaps it was after the style in which the comet is said to be fighting against two Cabinet Ministers in China. It is generally believed in that country that the appearance of a comet is an intimation from Heaven that his Imperial Majesty "The Continuation of Glory" must at once, under pain of heavy judgment, put down the misgovernment which prevails somewhere in the Empire. Now, the coincidence of the comet's apparition with the impeachment of two Ministers for bribery commends itself to the Celestial mind as a divine fiat against the accused. Wherefore the unfortunate functionaries are likely, whatever the human evidence of their guilt or innocence, to be sacrificed to the comet.

A FRENCH chemist claims to have discovered a method of overcoming the danger threatening vineyards from the ravages of the phylloxera. His process is to inoculate the vines with the phenol poison. The phylloxera do not attack plants thus treated, and are extirpated for want of food. The vines are in no way injured by the inoculation process.

CORRECTIONS are sometimes needed for corrections. Thus Mr. R. Tucker, in *Nature*, marks among the corrections to be made in the Memoir of Professor de Morgan, for Haussen, Hanssen, and for Hencke, Encke; but the first should be Hansen, and Hencke is right enough. Hencke, the discoverer of Astræa and Hebe, is referred to, not Encke the mathematician, whose name is associated with a comet of short period.

THE *Engineer* says:—"The electric light is coming extensively into use at Middlesbrough. The Yorkshire Electric Light and Power Company (Limited) has already commenced operations. Their plan is to supply Brush lights at a rental of £25 per annum per light, the renter paying also for carbons consumed, estimated to cost a further £5 per annum. Messrs. Jones Bros., B. Samuelson & Co., Gjers, Mills, & Co., and the North-Eastern Steel Co., have already become renters. The electric light will not, however, be without serious competition. The Gas Committee have undertaken to put up the Sugg lamp at Messrs. Fox, Head, & Co.'s works, free of cost to them, except so far as that they are to pay for the gas actually consumed. It is computed that the cost of supply of gas will not exceed one-sixth the cost of the electric light, and that the illuminating effect of the Sugg light, if not equal to its rival, will at all events be far ahead of anything which has been in use at rolling-mills before."

OLDEST TREE IN THE WORLD.—The oldest tree in the world, so far as any one knows, is the Bo tree of the sacred city or Amarapoora, in Burmah. It was planted 288 B.C., and is, therefore, now 2,170 years old. Sir James Emerson Tennent gives reasons for believing that the tree is really of this wonderful age, and refers to historic documents in which it is mentioned at different dates, as 182 A.D., 223 A.D., and so on to the present day. "To it," says Sir James, "kings have even dedicated their dominions, in testimony of a belief that it is a branch of the identical fig tree under which Buddha reclined at Urumelaya when he underwent his apotheosis." Its leaves are carried away as streamers by pilgrims, but it is too sacred to touch with a knife, and therefore they are only gathered when they fall. The king oak in Windsor Forest, England, is 1,000 years old.

COMMENTING on the communications of the Duke of Argyll, Emeritus Professor Blackie, and others, which have appeared in the *Times* in connection with the depopulation in the Highlands, a statement appears in the *Celtic Magazine* to the effect that since the census of 1831 the population of Argyllshire has actually declined from 100,973 to 76,468; and as to the latter number, no fewer than 30,387 are classified as urban. The conclusion arrived at is that the rural population has been reduced in the course of the last fifty years from 85,973 to 46,081, or nearly one-half.

HERR R. BASSEL, a Berlin engineer, who last year published an article in the *Centralblatt der Bauverwaltung* on the aqueduct of Betilienus at Altari, has recently made

further excavations, and has succeeded in recovering some of the lead pipes which conveyed the water. Many fragments of terra-cotta have also been found, probably indicating a factory.

During the excavation of the tramway tunnel through Posilippo an antique water conduit of singular interest was discovered, and examined by competent archæologists. The walls, of thick cement, contain inscriptions indicating the villas supplied with water. The dimensions of the conduit are such that people can walk erect inside. One of the inscriptions was made apparently after a partial restoration. It bears the name of Consul Nerva.

The *Globe* remarks, with reference to Mr. Julian Hawthorne's illness, and the consequent interruption of the story which he is contributing to a monthly magazine, that it would be well if no editor would allow a story to be commenced in the pages of a magazine until the MS. of the whole story was in his hands. Our contemporary refers to the fact that Dickens, Thackeray, and Mrs. Gaskell all left unfinished stories. The public would probably prefer that even part of a story should appear than none of it, on the principle that "half a loaf is better than no bread." If such an arrangement as is suggested by the *Globe* would have resulted in the completion of the novels referred to, it would have been well; but it would not have had that effect. It would only have delayed the appearance of the fragments. Fortunately, both Thackeray and Dickens left clear indications of the endings to which the unfinished stories were to have tended; so that one can take all the pleasure the fragments can give without the annoyance which would have arisen had the end been left in doubt. Thackeray actually tells us the *dénouement* of his novel; and though Dickens did not—indeed, rather tried to shroud the fortunes of the leading characters in mystery—the end is clearly foreshadowed for all who understand Dickens's style, and see how, in all his novels, the fate of each person is indicated by the tone of all relating to each from beginning to end. We believe that no one who reads the "Mystery of Edwin Drood" attentively can doubt that the end was to have been as suggested by Mr. Foster in the closing essay of "Leisure Readings" (Knowledge Library, Vol. V.).

The Hammond Electric Light Company informs the *Electrical Review* that "a Ferranti machine to run 5,000 lights, and weighing about two tons, is on the point of being finished; and if this works with the efficiency claimed for it, it will revolutionise the whole question of incandescent lighting from a central station. Applications under the Electric Lighting Act were made for every borough in England; but having got into friendly relations with a large number of corporations, the company have contented themselves with withdrawing their applications in order to become the contractors for the work of corporations."

Protective Inoculation of Animals.—There has now been time to form some idea as to the practical efficacy of M. Pasteur's method of vaccinating animals as a protection against the disease known in France as *charbon;* and some instructive statistics on the subject from the department Eure-et-Loire, where the disease has been very prevalent, have just appeared. About 80,000 sheep were there vaccinated a year ago, and since vaccination only 518 have died of *charbon*, or 0·65 per cent., whereas the mean annual loss from the disease during the last ten years has been 9·01 per cent. About 4,500 animals of bovine species have been vaccinated, and the mortality has fallen from 7·03 to 0·24 per cent. Vaccination has not been largely practised on horses, as it is apt to be followed in them by serious congestion, and their mortality from *charbon* is low. Last year, being a wet one, was less favourable to the development of *charbon*, and this might be thought to affect the statistics considerably. In order, therefore, better to judge of the effects of vaccination, some intelligent proprietors took occasion to vaccinate only a portion of their live stock. Thus 2,308 sheep were vaccinated and 1,659 not vaccinated, all being under the same conditions of life, and mixing freely with one another. Of the vaccinated animals only eight died; of the unvaccinated 60; and the latter number would be raised to 83 if there had been 2,308 unvaccinated. Thus we have 83 unvaccinated dead against eight vaccinated; the mortality in the former is more than ten times that in the latter.

In the United States, 9,171 miles of railway were made in 1882, as compared with 6,649 miles in 1881 and 534 miles in 1880.

The Telephone for Railway Purposes.—The London and North-Western Railway Company are fitting several of the new signal cabins at Eccles Junction and Patricroft with telephones. This will be a much readier mode of communication than that of the single-needle instrument, which, with its many advantages, is still inconvenient when the signalman has to attend to his electric and semaphore signals. For nearly twelve months telephones have been on trial between various points on this company's system, and notwithstanding the severe tests they have been put to, have universally demonstrated their superiority over the instruments previously used.

During the recent fearful continental floods, a kilomètre of the Simplon line, near Sierre, was destroyed by an earth-slip, and traffic has not yet been resumed. A steamer has been wrecked, with the loss of one life, on Lake Constance. The Thur has overflowed its banks, and all the country between Kappel and Lichtensteig is under water. The Val de Travers has been converted into a vast lake.

"Taranaki" writes that "Earle ('English Plant Names') gives Saxon '*mistil*, sprawler,' and '*tân*, twig or rod.' 'Sprawling-twig' seems to fit the plant capitally." The words, "mist," "mizzle," indicate the same meaning for root "mist," *scattered, dispersed*—thus a mizzling rain is finely divided or dispersed rain. "Mizzle," to run away, is, then, really old Saxon slang, like the American "scatter."

Lectures on Electricity.—A course of ten lectures on electricity will be given, at the instance of the London Society for the Extension of University Teaching, by T. W. Waghorn, Esq., R.N., in St. Jude's Schoolroom, Commercial-street, Whitechapel, E., on Tuesday, Jan. 16, and the nine following Tuesdays, at 8.15 p.m. The lectures will be illustrated by experiments, and will be intelligible to beginners. Each lecture will be followed by a class, in which the lecturer will be prepared to answer questions in elucidation of his lecture. The first lecture, on Tuesday, 16th inst., is free. Further information may be obtained from the Hon. Secs., F. Rogers, 62, Nicholas-street, Mile-end, E., and A. Milner, 54, Claverton-street, S.W.

THE CHEMISTRY OF COOKERY.

BY W. MATTIEU WILLIAMS.

THE philosopher who first perceived and announced the fact that all the physical doings of man consist simply in changing the places of things, made a very profound generalisation, and one that is worthy of more serious consideration than it has received.

All our handicraft, however great may be the skill employed, amounts to no more than this. The miner moves the ore and the fuel from their subterranean resting-places, then they are moved into the furnace, and by another moving of combustibles the working of the furnace is started; then the metals are moved to the foundries and forges, then under hammers, or squeezers, or into melting-pots, and thence to moulds. The workman shapes the bars, or plates, or castings by removing a part of their substance, and by more and more movings of material produces the engine, which does its work when fuel and water are moved into its fireplace and boiler.

The statue is within the rough block of marble; the sculptor merely removes the outer portions, and thereby renders his artistic conception visible to his fellow-men.

The agriculturist merely moves the soil in order that it may receive the seed, which he then moves into it, and when the growth is completed, he moves the result, and thereby makes his harvest.

The same may be said of every other operation. Man alters the position of physical things in such wise that the forces of Nature shall operate upon them, and produce the changes or other results that he requires.

My reasons for this introductory digression will be easily understood, as this view of the doings of man and the doings of Nature displays fundamentally the business of human education, so far as the physical proceedings and physical welfare of mankind are concerned.

It clearly points out two well-marked natural divisions of such education, education or training in the movements to be made, and education in a knowledge of the consequences of such movements, *i.e.*, in a knowledge of the forces of nature which actually do the work when man has suitably arranged the materials.

The education ordinarily given to apprentices in the workshop, or the field, or the studio—or as relating to my present subject, the kitchen—is the first of these, the second and equally necessary being simply and purely the teaching of physical science as applied to the arts.

I cannot proceed any further without a protest against a very general (so far as this country is concerned) misuse of a now very popular term, a misuse that is rather surprising, seeing that it is accepted by scholars who have devoted the best of their intellectual efforts to the study of words. I refer to the word *technical* as applied in the designation "technical education."

So long as our workshops are separated from our science schools and colleges, it is most desirable, in order to avoid continual circumlocution, to have terms that shall properly distinguish between the work of the two, and admit of definite and consistent use. The two words are ready at hand, and although of Greek origin, have become, by analogous usage, plain simple English. I mean the words *technical* and *technological*.

The Greek noun *techne* signifies an art, trade, or profession, and our established usage of this root is in accordance with this signification. Therefore "technical education" is a suitable and proper designation of the training which is given to apprentices, &c., in the strictly technical details of their trades, arts, or professions. When we require a name for the science or the philosophy of anything, we obtain it by using the Greek root *logos*, and appending it in English form to the Greek name of the general subject, as geology, the science of the earth; anthropology, the science of man; biology, the science of life, &c.

Why not, then, follow this general usage, and adopt "technology" as the science of trades, arts, or professions, and thereby obtain consistent and convenient terms to designate the two divisions of education—technical education, that given in the workshop, &c., and technological education, that which should be given as supplementary to all such technical education?

In accordance with this, the papers I am here commencing will be a contribution to the technology of cookery, or to the technological education of cooks, whose technical education is quite beyond my reach.

The kitchen is a chemical laboratory in which are conducted a number of chemical processes by which our food is converted from its crude state to a condition more suitable for digestion and nutrition, and made more agreeable to the palate.

It is the *rationale* or *ology* of these processes that I shall endeavour to explain; but at the outset it is only fair to say that in many instances I shall not succeed in doing this satisfactorily, as there still remain some kitchen mysteries that have not yet come within the firm grasp of science. The *whole* story of the chemical differences between a roast, a boiled, and a raw leg of mutton has not yet been told. You and I, gentle reader, aided by no other apparatus than a knife and fork, can easily detect the difference between a cut out of the saddle of a three-year-old Southdown and one from a ten-months-old meadow-fed Leicester, but the chemist in his laboratory, with all his re-agents, test-tubes, beakers, combustion-tubes, potash-bulbs, &c., &c., and his balance turning to one thousandth of a grain, could not physically demonstrate the sources of these differences of flavour.

Still I hope to show that modern chemistry can throw into the kitchen a great deal of light that shall not merely help the cook in doing his or her work more efficiently, but shall elevate both the work and the worker, and render the kitchen far more interesting to all intelligent people who have an appetite for knowledge, as well as for food, than it can be while the cook is groping in rule-of-thumb darkness—is merely a technical operator unenlightened by technological intelligence.

In the course of these papers I shall draw largely on the practical and philosophical work of that remarkable man, Benjamin Thompson, the Massachusetts' prentice boy and schoolmaster; afterwards the British soldier and diplomatist, Colonel Sir Benjamin Thompson; then Colonel of Horse and General Aide-de-Camp of the Elector Charles Theodore of Bavaria; then Major-General of Cavalry, Privy Councillor of State and head of War Department of Bavaria; then Count Rumford of the Holy Roman Empire, and Order of the White Eagle; then Military Dictator of Bavaria, with full governing powers during the absence of the Elector; then a private resident in Brompton-road, and founder of the Royal Institution in Albemarle-street; then a Parisian *citoyen*, the husband of the "Goddess of Reason," the widow of Lavoisier; but above all a practical and scientific cook, whose exploits in economic cookery are still but very imperfectly appreciated, though he himself evidently regarded them as the most important of all his varied achievements.

His faith in cookery is well expressed in the following, where he is speaking of his experiments in feeding the Bavarian army and the poor of Munich. He says:—"I

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constantly found that the richness or quality of a soup depended more upon the proper choice of the ingredients, and a proper management of the fire in the combination of these ingredients, than upon the quantity of solid nutritious matter employed; much more upon the art and skill of the cook than upon the sums laid out in the market."

A great many fallacies are continually perpetrated, not only by ignorant people, but even by eminent chemists and physiologists, by inattention to what is indicated in this passage. In many chemical and physiological works may be found elaborately minute tables of the chemical composition of certain articles of food, and with these the assumption (either directly stated, or implied, as a matter of course) that such tables represent the practical nutritive value of the food. The illusory character of such assumption is easily understood. In the first place the analysis is usually that of the article of food in its raw state, and thus all the chemical changes involved in the process of cookery are ignored.

Secondly, the difficulty or facility of assimilation is too often unheeded. This depends both upon the original condition of the food and the changes which the cookery has produced—changes which may double its nutritive value without effecting more than a small percentage of alteration in its chemical composition, as revealed by laboratory analysis.

In the recent discussion on whole-meal bread, for example, chemical analyses of the bran, &c., are quoted, and it is commonly assumed that if these can be shown to contain more of the theoretical bone-making or brain-making elements, that they are, therefore, in reference to these requirements, more nutritious than the fine flour. But before we are justified in asserting this, it must be made clear that these ordinarily rejected portions of the grain are as easily digested and assimilated as the finer inner flour.

I think I shall be able to show that the practical failure of this whole-meal bread movement (which is not a novelty, but only a revival) is mainly due to the disregard of the cookery question; that whole-meal prepared as bread by simple baking is less nutritious than fine flour similarly prepared; but that whole-meal otherwise prepared may be, and has been, made more nutritious than fine white bread.

Count Rumford supplies us with important data towards the solution of this difficulty.

Another preliminary example. A pound of bread or biscuit contains more solid nutritive matter than a pound of beefsteak, but does not, when eaten by ordinary mortals, do so much nutritive work. Why is this?

It is a matter of preparation—not exactly what is called cooking, but equivalent to what cooking should be. It is the preparation which has converted the grass food of the ox into another kind of food which we can assimilate very easily.

The fact that we use the digestive and nutrient apparatus of sheep, oxen, &c., for the preparation of our food, is merely a transitory barbarism, to be ultimately superseded when my present subject is sufficiently understood and applied to enable us to prepare the constituents of the vegetable kingdom in such a manner that they shall be as easily assimilated as the prepared grass which we call beef and mutton, and which we now use only on account of our ignorance of "The Chemistry of Cooking."

An international Exhibition of industrial and principally electrical objects is being organised by the Bohemian Architekten und Ingenieur-Verein, at Prague, to open on March 17.

PLEASANT HOURS WITH THE MICROSCOPE.

By Henry J. Slack, F.G.S., F.R.M.S.

Every possessor of a microscope should exercise its powers upon common things. Many such will exhibit unexpected beauty, and throw light upon very interesting questions. A potato, for example, may be recommended as an excellent subject of investigation; but as polarized light will be required for some of the observations, it may be well to say a little about it, leaving it, however, as a subject for some other contributor at a convenient time. "In a beam of ordinary light," says Professor Tyndall, "the vibrations occur in all directions round the line of propagation." Some crystalline substances can effect an important change. Tourmaline, for example, cut in a particular way, will "quench all vibrations save those parallel to its own optical axis. Hence the beam emergent from the plate of tourmaline has all its vibrations reduced to a single plane. In this condition it is a beam of *plane* polarized light." Iceland spar, in the shape of the prisms supplied by opticians, has a like effect, and when light has been polarised by one of them, it will not pass in all directions through a similar prism. When used with the microscope, one prism is placed under the stage to receive light from the mirror, and another just over the objective, or over the eye-piece. If the two prisms cross each other in a certain direction, no polarized light passes; but if what is called an analysing substance is placed between them, it restores to the light its power of passing through the second prism, and frequently, in so doing, the light waves interfere with each other, and give rise to coloured effects. Polarized light is acted upon by many substances, whose molecules are so arranged that they can vibrate more easily in some directions than others; and the potato contains one of these in the form of starch.

First, with a sharp penknife make a very thin slice of the potato, about half-an-inch square, and view it with a half-inch objective and the polarizing apparatus. When the two prisms let the light pass freely, the potato will appear to be composed of small cells of pretty uniform aspect. Turn one of the prisms so as to produce a dark field. If the potato is flowery, a vast number of little cells will then be brilliantly lit up, while their neighbours are dark. The light ones will be marked by a black cross, and some may show prismatic colours. These cells are starch grains, and constitute the chief value and give the pleasant flavour of a mealy tuber. They are of all sizes, from about a two-hundredth-of-an-inch long, down to tiny ones scarcely visible with the power mentioned. Each starch grain is a little delicate bag, longer than wide, and approximately egg-shaped. The cross is like what might be made by drawing two dark lines at right angles to each other on an egg, beginning at the top of the thickest end. The peculiar action of starch upon the polarized light affords a very ready means of recognition, but it is not the chemical substance, starch, which produces the effect, but the thin skin or vesicle, and if that is ruptured or destroyed, the cross appears. Another mode of recognising starch is to bring it in contact with a weak solution of iodine, which turns its purplish tending to black.

After trying the potato, other common substances in family use should be examined. Brown & Polson's Corn Flour produces a beautiful effect with the polarizing prisms. It is nearly all starch—ostensibly of maize. The vesicles are much smaller than the largest of the potato, but give brilliant images. *Tous-les-mois*, obtained from a South

American Canna, shows the starch grains well, and they constitute the chief matter in all the articles sold as arrow-root. Genuine cocoa does not exhibit any conspicuous quantity of starch; but some of the articles commonly sold for cocoa contain it in large quantities. Anything called cocoa or chocolate, or by any grand name, which gets thick when mixed with hot water may be suspected to be mainly starch, and as that from the potato and from any of the things called "arrowroot" are low in price, it is very profitable to sell such mixtures at the rates usually charged. The microscope at once detects the adulteration. For a fair standard, the cocoa of Van Houtten or Cadbury's Essence may be taken, and the difference between either of them and the inferior mixtures will be strikingly apparent.

Starch is a very curious product of the vegetable kingdom. Like some others of different chemical constitution, it is stored up in grains when the nutrition of a plant is so vigorous that it can afford to lay up something for the future as an investment. Cultivation enables us with some plants, as the potato, to cause a much larger quantity to be stored up than the vegetable can possibly want for its own purposes, but which is useful to us, or to our domestic animals, as food. If large starch grains are examined with a high power and careful illumination, but without the polariscope, a curious wrinkled structure will be seen. All starch grains begin as minute round vesicles, and, if the plant can afford to feed them, they grow pretty quickly in a state of dependence upon, but not directly serving the general organism, except by relieving it of matter which is superfluous, and would be harmful if not kept out of its assimilative system until it may be specially required. The starch in each vesicle is not a single substance. There are two kinds, one easily soluble and the other nearer to cellulose. The grains do not grow like common cells. If magnified about 800 diameters, their wrinkles or folds will plainly distinguish them from the other kinds of cell formations. An advanced student can refer to such a work as Sach's "Text-Book of Botany" for details of the process of starch-grain development. The main fact is, that after a layer of the vesicle is fully formed, it splits, and allows new matter to penetrate and intercalate fresh layers, and so on until a fully-developed grain exhibits a dozen or two of wrinkles.

It is said in Miller's "Chemistry" that the cross produced by polarised light is not perceptible in the starch of wheat flour, but this is only true if too low a power is used. It is easily seen with a one-eighth. If readily visible with lower objectives, and the grains are large, the starch of the potato is probably present. Chemically, starch belongs to the hydrocarbons. Its composition is given as $C_6H_{10}O_5$, together with a small quantity of mineral matter. By heat it can be converted into British gum, largely used by calico-printers to mix with their colours, and for various other purposes as a cheap substitute for gum-arabic.

A NEW company has been registered, the following particulars of which may be interesting. It is called the Electrical Rotary Brush Company (Limited), capital £100,000, in £1 shares. Objects: To purchase letters patent, No. 2,562, for "Improvements in the method or means of and appliances for communicating a rotary motion to brushes employed for various purposes, but specially for brushing hair." The purchase consideration is £15,000 in fully paid shares and £35,000 in cash. Directing qualification, shares or stock to the nominal value of £25. Remuneration, 100 guineas per annum in respect of each director, with an additional 200 guineas for the chairman.

THE ELECTRIC LIGHT COMPANIES.

WE, in common with some of our contemporaries, have for some time past esteemed it a part of our duty to animadvert upon the unscrupulous way in which efforts have been made to foist upon an apparently gullible public electric lighting speculations, with scarcely a chance of prolonged existence, to say nothing of the return for which shareholders usually, and naturally, look as a reward for their temerity. What has long been a desideratum is a tabulated list of the various companies embarked, with particulars as to their financial position and prospects. The work involved in the production of such a list is obviously considerable—one might almost say prodigious. It has, however, been attempted, and, we think, with a great measure of success, by the *Mercantile Shipping Register and Commercial Review*, who publish the result of their labours in the form of a special annual supplement. It comprises details of the constitution, progress, and resources of all the registered companies, together with a number of explanatory tables, &c., the perusal of which is calculated to instil in one's mind an intense feeling of amazement at the rapacity of promoters, and the comparative generosity of the earlier inventors.

The various companies on the register are divided into four groups, in the first of which are classed the parent Brush Companies and its eighteen satellites. Two of these are apparently not yet in working condition. The other seventeen have a combined nominal capital of £5,125,000. The actual capital issued is £2,697,318, including £555,180 allotted to vendors. The amount "paid up" by the public is £1,180,685, leaving £961,453 as the extent of their remaining liability. Out of the £1,180,685, the sum of £614,170 has been paid to vendors, in addition to the shares above mentioned. The parent company paid for its rights over the Brush patents £200,000 in cash and shares. These rights had been purchased from another company, who, in its turn, had paid to J. T. Montgomery £22,000 (£10,000 in cash), and to C. F. Brush £5,000 in shares. It has not transpired how much Montgomery paid for his interest, but sufficient is known to demonstrate how very small, in comparison, was the sum that fell into the hands of Brush himself. Besides the Brush patents, the Brush Company also possesses an incandescent lamp, which it "purchased from Mr. Lane-Fox, subject to the rights of the British Electric Light Company, for 1,250 shares, £4 paid, £718 in cash to cover certain expenses, and 25 per cent. on the net profits of the incandescent lights; Mr. Lane-Fox to give his services for two years, at £1,000 a year." Our readers will remember that this costly concession was recently described by the counsel for a subsidiary company as worthless! The British Company are apparently of a somewhat similar opinion, as they make little, if any, use of their right to the Lane-Fox lamp. It is not stated how much the last-mentioned company paid for the right to use the lamp in certain extensive parts of the kingdom. The Brush Company has received from ten companies £402,750, the amount received from the other offshoots not being stated.

The second group embraces twenty-three "working companies other than the Brush," whose combined nominal capital amounts to £10,675,500, of which £5,191,128 has been issued, including £2,581,955 allotted to vendors. Of the £2,609,173 taken up by the public, £1,038,409 has been paid, leaving a liability of £1,570,764. A sum of £462,775 has been paid to the vendors, in addition to the shares allotted them. The cash payment is, however, much smaller than that originally agreed upon. The most remarkable company in this series is the "J. B. Rogers"

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Electric Light and Power Company (Limited), which was formed to work the patents of John Banting Rogers, a gentleman who has obtained an unenviable notoriety in scientific circles. £40,000 in cash and £70,000 in shares was to have been the cost of his patents, but, fortunately for the public, only £15,715 has been subscribed, of which but £6,286 has been paid. The smallness of these figures is gratifying, considering the almost universal and unequivocal plaudits bestowed by the general and quasi-scientific press upon the "multiple binding-screw" craze. Messrs. Ferranti, Thompson, & Ince (Limited), out of a nominal capital of £240,000, pay £180,000 in shares to the vendors.

In the third group are enumerated fourteen "companies which do not appear to have been proceeded with practically," including the "Self-generating Electric Light and Power Company" (unregistered), which, if formed, was to pay a Mr. R. H. Simons £80,000 in cash and £40,000 in shares for an incandescent lamp which he hoped to invent (!) and a bichromate battery. The combined nominal capital in this series is stated at £4,450,000, of which the vendors were to receive £405,986 in cash and £1,035,036 in shares.

The fourth group embraces thirteen "companies, mostly recent, information about which is wanting, or not yet obtainable."

"We find from our figures," says our contemporary, "that the amount of actual capital issued, £7,888,446, was 48 per cent. of the nominal total of the capital of the companies comprised in Groups I. and II., and but 38 per cent. of that of those comprised in Groups I., II., and III. Of this issued amount, again, 40 per cent. has been allotted as fully paid up to vendors, &c., leaving 60 per cent.—*i.e.*, under 23 per cent. of the whole nominal amount—to be paid up by the public. Roughly, eleven twenty-thirds of this has been already paid. That is to say, in the case of these companies (which do not include syndicate, agency, or share trust associations), a sum equal to 11 per cent. of the total registered capital represents the actual amount of public money received, while 12 per cent. of the same amount forms the extent of liability on future possible calls. Thus, out of a total nominal capital of something under twenty-five millions sterling, less than two millions and three-quarters has been *bonâ-fide* invested, while the amount of shareholders' indebtedness stands at a trifle over three millions.

"Out of the total paid-up capital, £2,219,094, £1,076,945 has found its way into promoters' pockets, leaving £1,142,049 as working capital to earn a dividend upon £5,356,229 share capital. In other words, to pay a 5 per cent. dividend all round, over 23 per cent. must be earned, net, by the moneys actually employed in working the business. Even if all calls were made and paid, and thus absorbed as working capital, over 10 per cent. would have to be earned."

The shareholders have themselves to blame for this state of affairs, for had they, instead of relying upon the science of the daily press, consulted trustworthy sources, they would have learned sufficient to guard them against the threatened danger. It is to be feared that, although the money sunk in electric light undertakings is comparatively very small, the effect will be very prejudicial to the true interests of the new illuminant, and we trust that the stock-jobbing excitement observable last May, when no less than thirty-five companies were registered, will never be repeated. There is a wide field open for real business companies having to earn profits for a working capital only, and we shall look forward somewhat anxiously to the coming spring, when will probably be decided the fate of very many undertakings, and, possibly, the prospects of the light for years to come; but we should seriously deprecate anything like a recurrence of the events of the past eighteen months.

WAS RAMESES II. THE PHARAOH OF THE OPPRESSION?

By Amelia B. Edwards.

XVI.—TEL-EL-MASKHUTA *VERSUS* THE "RAAMSES" OF THE BIBLE (EXAMINATION OF THE EVIDENCE).

(*Conclusion.*)

6. *Pa-Rameses was supplied with salt and nitre from two neighbouring pieces of water.* We learn these facts from the Letter of Panbesa* :—

"The Pool of Horus gives salt;
Lake Pahura gives nitre."

Lake Pahura, as suggested by Dr. Birch, is doubtless one of the "Bitter," or Natron, Lakes in the Isthmus of Suez ("Records of the Past," vol. vi., p. 14). The name of this lake, Pahura, has not, I believe, been found in the geographical lists, or anywhere save in the letter of Panbesa.

The "Pool of Horus" is, however, identical in name with the "Shet-Hor" (Pool of Horus) of the inscription of Menephthah at Karnak before quoted :—

"He established outposts before *Pa-Baris* (Bubastis) in the vicinity of the canal *Shakana*, to the north of *Shet Hor*" (Pool of Horus).†

This is the only occasion upon which the name *Shakana* has as yet been found; but if the "Pool of Horus" here referred to be the same "Pool of Horus" celebrated by Panbesa, then we have to look for the canal in the near neighbourhood of Bubastis and Pa-Rameses, and for the pool somewhere to the southward of the canal. Now, were Bubastis and Pa-Rameses both situate in the open country, and surrounded by a network of water-ways, we might seek in vain for a probable identification of *Shakana*; but the question is narrowed to a single issue by the peculiar position of the *Bekhen* of Rameses II. Stationed midway of a contracted valley traversed by one artificially-constructed canal, the waters of which were "derived from the Nile a little above the city of Bubastis,"‡ it becomes evident that the only canal which could be regarded as in the neighbourhood of both Bubastis and Pa-Rameses is that ancient and famous waterway of Seti the First, called "*Ta Tena*," or "The Cutting." In this case, *Shakana* is but another, and perhaps a more modern, name for "*Ta Tena*." But, it may be urged, we have no proof that these two Pools of Horus were one and the same; and, again, Egyptologists may perhaps remind me that M. Chabas, noting the not unfrequent recurrence of the name "*Shet-Hor*" in Egyptian texts, observes "qu'il y a lieu de remarquer que ce nom est du nombre de ceux qui ont pu être multipliés par la piété des Egyptiens." To this objection, however, the improbability that two pieces of water so nearly adjacent should be called by the same name, is a sufficient reply.

Assuming that the canals *Shakana* and *Ta Tena* are identical, we have now to seek for the site of the Pool of Horus.

Turning to the sketch-map of Wady Tûmilat, at p. 357, in the second volume of Knowledge, it will be seen that

* See Knowledge, Oct. 13, 1882, p. 324.

† Thus translated by Chabas ("L'Antiquité Historique," p. 203) and by Dr. Birch ("Records of the Past," vol. iv., p. 41).

‡ Herodotus, book ii., chap. 158.

in two places a dotted line (numbered 6) marks where the French engineers, under M. de Lesseps, discovered the excavated bed, and even some of the masonry, of the canal of Seti I. At these points, the ancient channel was merely deepened and widened; so that the new Freshwater Canal partly flows in the very path of the old one. To show this in our map was, of course, impossible; the dots indicating the ancient waterway are, therefore, placed under the line (No. 7) which represents its modern successor.

Bearing in mind that the canal *Shakana* is expressly described as "North" of *Shet-Hor*, it is not a little startling to see, on first glancing at our map, a piece of water occupying the precise position which we should expect to see occupied by the Pool of Horus. This piece of water (No. 11 on the map) is Lake Mahsamah,* a large pool formerly filled by the high Niles, and now utilised as a reservoir by the Canal Company. Writing to the *Academy* upon this subject in 1880,† I expressed my belief that the *Shet-Hor* of the Karnak inscription, the *Shet-Hor* of Panbesa's letter, and Lake Mahsamah, were all one and the same. Taking into consideration, however, a difficulty to which I did not then attach sufficient importance, I find myself obliged to reject this tempting identification.

"The Pool of Horus gives salt,"

says Panbesa; whereas Lake Mahsamah is, and always must have been, a fresh water deposit. Salt pools, however, are no rarity in this neighbourhood, where every marshy lagoon near the head of the Red Sea is a natural salt factory. The bed o fthe Great Bitter Lake contains a bank of solid salt, seven miles long by five miles broad, and the northern extremity of this lake is only ten miles south of the latitude of the ancient Canal. Assuming that in the time of Menephthah the head of the Red Sea was where it now is, I see no reason why the Great Bitter Lake itself may not have been the Shet-Hor of the letter and the inscription. It was certainly the most likely source from which the inhabitants of Pa-Rameses would have procured their supply of salt; and the canal *Shakana*, or *Ta Tena*, lay to the north of it in those days, just as the new Freshwater Canal lies to the north of it in ours. And it is important to note in this connection that the only opening towards the frontier in the neighbourhood of Bubastis, and therefore the only point at which the extra outposts of the Karnak inscription would be required, is Wady Tûmilat. That inscription,‡ moreover, goes on to say that the district which needed defence on this side, was "all pasture land," and that "in the time of the ancestors" (meaning under the earlier dynasties) it had been "infested by barbarians." Now the land of Goshen was essentially a pasture district, and was for that reason assigned to the Israelites, who were herdsmen and shepherds; also Wady Tûmilat was a direct short cut, leading from the desert haunts of the Shasu Bedaween into the heart of these fair pasturages—the pasturages and pools ("*Barbakuta*") of the neighbourhood of Pa-Tûm.§ The invading Hykshos, we may be sure, poured in through this valley, as well as over the more northern boundaries of the same frontier; and the foregoing allusion to the "barbarians" of ancestral times may quite possibly be a reminiscence of those terrible guests.

Thus we see that under the reign of Menephthah the condition of the eastward frontier was more unsettled than during the reign of Rameses II., and that the fortresses of Pithom and Rameses were no longer deemed a sufficient defence on that side. This conclusion is fully borne out by all that we know of the history of the time. During the last years of Rameses II., the vast empire over which he ruled was with difficulty held together by the mere prestige of his great name; but his death was followed by invasions of the lawless frontier tribes, revolts of oppressed tributaries, and the exodus of the industrious and long-suffering Hebrew colonists.

7. *Pa Rameses contained a temple dedicated to Rameses II., deified.* This last point hinges so entirely upon all which has gone before, that it may be said to stand or fall with the case I have attempted to prove. If I have identified the place, then I have also identified its local cult and all connected therewith. If "Ramsis" be a corrupt survival of "Rameses," and both are the "Raamses" of the Bible—if Tel-el-Maskhuta does in truth entomb the ruins of that *Bekhen*, or "treasure city," celebrated in the inscription of Pthah-Tatunen at Aboo-Simbel, in the Anastasi papyri, Nos. II., III., and IV., and in the Great Hieratic papyrus of Bologna—then we know, as surely as the fact can be known before the mound is excavated, that therein will be found the remains of a "Royal Abode"* (in other words, a temple) of Rameses Mer-Amen; that "Rameses Mer-Amen was its god:† and that "festivals were there celebrated" for him, even as festivals were celebrated at Memphis for Phtah, the great primordial deity.‡ The paved way, or dromos, leading to that temple, and two of the sphinxes by which the dromos was bordered, have been found, as already stated,§ at some little distance from the mound; and that the ruins of the temple are buried in the heart of that mound is an inference which cannot fail to be drawn by all who are acquainted with the general plan of an Egyptian temple of this period.‖ Neither can it be doubted that the sculptured slab described in Chap. XIV.¶ belonged also to this temple, or to a subordinate chapel connected therewith. This slab (of which an illustration is given in Sir Gardner Wilkinson's "Materia Hieroglyphica" (App. No. 4) is described by the Abbé Vigoureux as "an immense block of granite, representing on its face a bas-relief group of a Pharaoh seated between the God Ra and the God Tum. This Pharaoh is no other than Rameses II., whose name occurs six times in the inscription engraved upon the back of the block."** These two deities, Ra and Tum, personify the rising and the setting sun, and, as M. Grébaut has shown, they were held reciprocally to engender each other; Ra, towards the decline of day, becoming the parent of Tum, and Tum, as morning approached, becoming the parent of Ra. Pa-Tum and Pa-Rameses were, therefore, if not actually "twin-cities," as I formerly suggested, at all events cities closely connected in regard of the mythical relationship of their local deities; the cult of the one god being, in fact, the complement of the cult of the other. They are cities which we might expect to find at no great distance apart; as, in truth, we do find the mounds of Tel Aboo-Sooleyman and Tel-el-Maskhuta.

And here—while deprecating the too complimentary

* Lake Mahsamah, on the border of which stands Mahsamah village, where our cavalry during the late campaign made a dashing attack and captured several trains.

† The *Academy*, April 24, 1880.

‡ See KNOWLEDGE, No. 50, p. 325, Vol. II.

§ *Ibid.* Report of a captain of the frontier guard, respecting the passage of certain Shasu and their herds.

* KNOWLEDGE, Sept. 29, 1882, p. 292. † *Ibid.*

‡ *Ibid.*, p. 292. § *Ibid.*, Dec. 8, 1882, p. 450.

‖ See the diagrams of Egyptian temples in Murray's "Handbook for Egypt," Vol. I., pp. 74 and 75.

¶ KNOWLEDGE, Dec. 8, 1882, p. 450.

** See "La Bible et les Découvertes Modernes." F. Vigoureux. Vol. ii., p. 209.

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terms in which reference to myself is made—I must take note of the objection to this part of my argument which has been advanced by Prof. G. Ebers in the second edition of his "Durch Gosen zum Sinaï" (p. 515). Speaking of my letter to the *Academy* of April 24, 1880, he first states my opinion as to the correlative nomenclature of Pa-Tum and Pa-Rameses; then goes on to say that "the places referred to are not twin-cities, and therefore situate close together, in Miss Edwards's sense, since Rameses is not named after the God Ra, but after the King Rameses, the offspring of the sun."

But to this I reply that the King Rameses was by himself virtually identified with Ra, his divine father, and that he considered himself not merely the "son of the Sun," but the actual incarnation of Ra upon earth. He certainly held himself to be sufficiently a god to be a correlative to Tum in the naming of his two treasure-cities, and in the dedication of their respective temples.*

Having made this objection, Professor Ebers goes on to express his approbation of various other points suggested in the letter in question, dwelling especially on my contention that "Ramsis," as the name of the native village at the foot of Tel-el-Maskhuta,† must be a survival of the ancient name of the place. "Also," he writes, "the remark that the Pharaoh of the Oppression (Rameses II.) made the Jews build *new* towns,‡ should not remain unnoticed." I am very glad to take this oppertunity of expressing the gratification with which I find my views upon this important matter confirmed by the approval of so eminent an authority.

And now, having gone over every point of the topographical, documentary, and historical evidence connected with the cities of Pa-Tum and Pa-Rameses, and having verified these items of evidence, one by one, with the mounds of Tel Aboo-Sooleyman and Tel-el-Maskhuta, I at last find myself at the end of a lengthy and a somewhat laborious inquiry. It is now so long since I began that inquiry, that the primary object with which it was undertaken has almost dropped out of sight. That object was to ascertain if possible—or as nearly as possible—whether Rameses II., whose mummy was discovered in the famous hiding-place at Dayr-el-Bakaree, in July, 1881, was, or was not, that Bible "Pharaoh" who oppressed the Hebrews. To this Biblical problem there exists but one really definite clue, that clue being the name of one of the "treasure-cities" which the Hebrews were compelled to build under circumstances of such exceptional rigour that the making of "bricks without straw" has passed into a common proverb. For "Raamses," or Rameses, is evidently so called after the name of its founder, just as Alexandria was called after Alexander, Constantinople after Constantine, St. Petersburg after Peter the Great, and Pennsylvania after William Penn. From among thirteen kings of the name of Rameses, it is not difficult to select the only one whose epoch, surroundings, and length of reign coincide even approximately with those of the Pharaoh of the Bible. This king is Rameses II. If it can, therefore, be shown that Rameses II. was indeed the founder of either, or both, of two *Bekhennu*, or fortified frontier cities, called Pa-Tum and Pa-Rameses, situate in the land of Goshen; and if the very mounds which cover the ruins of those cities can be identified with a reasonable degree of certainty, then, not only is an interesting problem in a fair way to be solved, but we have almost gained an historical standpoint of supreme importance for purposes of future inquiry. From this standpoint, when it is finally reached, we may hope to obtain a clear outlook over the vast field of ancient history; while, as a basis for calculation, it will unquestionably enable us to determine a long chain of chronological and astronomical data.

Having brought together and compared all the scattered items of evidence which bear upon this question, I must leave others to decide whether I have, or have not, succeeded in proving my case as far as it can be proved without the decisive help of pick and spade. That pick and spade may ere long be called in to settle this problem, and others of still greater moment, is, however, my earnest desire. And if what I have written has awakened in any of my readers not only a curiosity to solve the secret of Tel-el-Maskhuta, but a willingness to promote that project for the excavation of the historic mounds of the Delta,* which is the great object of my labours and my hopes, I shall be more than content.

* At Aboo-Simbel, for instance, in the Great (rock-cut) Temple made by Rameses II., we find Rameses the God enthroned among the deities of the inner sanctuary; and, more monstrously significant than all the rest, a bas-relief on the walls of the same temple represents Rameses the Pharaoh burning incense before Rameses the God.

† Knowledge, Dec. 8, 1882, p. 450.

‡ *Ibid.*, Sept. 8, p. 244; also, Jan. 12, p. 22.

NIGHTS WITH A THREE-INCH TELESCOPE.†

By a Fellow of the Royal Astronomical Society.

AN examination of the one Circumpolar constellation yet undescribed—we mean Cepheus—will complete our survey of the Heavens; round the whole 24 hours of which we have now travelled. To begin with, the reader may find a very severe test for the light-grasping power of his instrument, and the excellence of his own eye, in 191 of Piazzi's Hour II., which lies at a distance of some 10° on a line leading from the Pole Star to β Persei. The components are close, and the observer will need a very dark night and excellent definition to see the companion at all. κ Cephei (shown, but not lettered, in the map in an odd little corner of the constellation running into Draco) is a fine pair, which will be seen as in fig. 69. β is a wider and also an unequal pair. In each of these cases the small star is blue. To the east-north-east of α Cephei is a vertical line of small stars. The upper one of these is ξ, a tolerably close and somewhat unequal pair, which will repay examination. It is represented in fig. 70. δ Cephei is a beautiful object, being, as Webb says, "something like β Cygni." Finally we arrive at o Cephei, a very close and unequal pair, delineated in fig. 71. Both in this and δ the small stars are blue, as are, curiously, so many of the comites in this constellation.

We may say in conclusion that in this series of papers we have simply endeavoured to describe a few of the chief and most easily-recognizable objects on the face of the celestial vault, that are well within the optical power of a three-inch telescope. Had we been justified in assuming that all our readers were in possession of the admirable

* See "Egyptian Antiquities," the *Times*, March 30, 1882; also "Proposed Excavation in the Egyptian Delta," the *Academy*, April 1, 1882.

† We have omitted for the present matter relating to the constellations Capricornus, Equuleus, Pegasus, and Pisces, which was originally to have appeared earlier. This will be given in due season, such as "The Stars in their Seasons" will indicate. F.R.A.S. has obligingly promised to write the papers mentioned in the last paragraph of the present paper, and they also will appear in due season, alternating with the valuable papers on Microscopic Work contributed by Mr. Slack.

"Star Atlas," by the Editor of KNOWLEDGE, we might have extended our list almost indefinitely. Even as it is, we may be permitted to express a hope that we have not wholly failed in our attempt to indicate what a mine of instruction and delight lies before the possessor of even so small an instrument as that to which our descriptions have had reference. We have said nothing of what may be observed in the Moon, or the Sun, or of the planets Mercury and Venus.

Fig. 69. Fig. 70. Fig. 71.

κ Cephei. ξ Cephei. ο Cephei.

In the case of lunar observation alone, a very large amount of work of the most interesting possible character may be accomplished by the aid of a three-inch telescope, and should any considerable number of our brother readers feel sufficient interest in selenography to desire it, we shall be willing to give such directions and details in papers supplementary to this, as may enable them to commence and follow the study of the Moon's surface to the greatest advantage. A single paper might, if required, suffice to deal with the Sun and (what we may call) the two daylight planets. Finally, in connection with the stellar portion of our subject, we may say here, that should any possessor of a three-inch telescope desire to verify what he may have heard or read with reference to spectrum analysis, as applied to these distant suns we have been examining, McClean's Star Spectroscope is the only one at all applicable to such an instrument as that whose employment we have presupposed. With that exceedingly ingenious little instrument the spectra of such stars as Sirius, Vega, Aldebaran, and Orionis, and other bright ones, may be very well seen indeed, even in a three-inch telescope.

OUR BODIES:

SHORT PAPERS ON PHYSIOLOGY.

BY DR. ANDREW WILSON, F.R.S.E.

No. IV.—LIFE AND WORK.

IF there is any word in the English language which may be considered well-nigh synonymous with,or equivalent to, "life," it is the word "change." At least, I can find no other term which, within the compass of a single word, expresses so succinctly the great characteristic of living beings. Life itself, whether viewed from a general, or from a microscopic and more intimate standpoint, is a series of changes, prevailing throughout the body that lives, and working out in the daily and hourly existence of the frame. Physiology is the "Science of *Functions*," and the business of the physiologist, briefly stated, is merely that of chronicling and explaining the changes through which the living body passes in the course of its history. Let us briefly regard these changes in the first instance, by way of gaining a clear notion of the general course of the events which constitute the "life" so-called, equally of man and the monad.

It may appear to be a paradoxical statement, and yet it is one involving the gravest truth, that a human body at any given moment is not precisely the same in respect of its weight, substance, and composition, as at the preceding moment, or at the subsequent one. At no moment of existence do the changes—chemical and physical—of which our bodies are the continual theatre, cease. This fact is susceptible of convincing proof. If we weigh a man before he performs an hour or two of hard work, and then weigh him again after the performance of his task, we shall find him to be appreciably lighter. He has lost substance through the actions involved in doing the work; and physiology is able to trace where that substance has gone. With every breath the man gave out, so much of his substance disappeared in the form of (1) *carbonic acid gas;* (2) *water;* (3) *heat;* (4) other waste matters (*ammonia, urea,* etc.); whilst we may add that he has been evolving and exerting a greater or less amount of *mechanical force,* or in plain language *work.* In truth, the waste matters which a living body is constantly emitting, and the loss of substance the body undergoes, is the result of the *work* it performs. There is the closest parallel to be drawn between a living body in this respect and a steam-engine. The latter works, and as the result of its work exhibits wear and tear. If the work is great, the waste will be proportionately great. And so with the body. Work, there, means waste, as in the machine, and like the machine, the living being wastes in proportion to the work it performs.

It is quite evident, however, that the changes we have described are, in themselves, far more complicated than might at first sight be supposed. The living body is the seat of changes and actions of intricate *chemical* nature. For instance, we know that without *heat* the bodily processes—or, what is much the same thing, life itself—would cease. How is heat produced in a living body? The answer is, much in the same way that heat is evolved in a fire. The *oxygen* gas contained in the air we breathe, unites with certain materials — *carbon* and *hydrogen*—contained in the blood. The result of this combination is the production of heat; whilst water and carbonic acid gas are also given off, and form the literal "ashes" of the bodily fire. Thus constant chemical change produces the heat necessary for life's continuance, and it can be proved that the quantity of carbon and hydrogen uniting with oxygen within the body in a known period, will account for the heat which is evolved during that period of time. As also illustrating the chemical changes which the living body undergoes, we may cite the intricate actions connected with the digestion of food in the mouth, stomach, and intestine. Our very existence in its plainest phases, is, in truth, maintained through the constant operation of a chemistry, which, though it may be called "vital," is in reality one with the chemical operations which we see taking place in nature around us.

The constant nature of the changes which occur in a living body has already been insisted upon. There is no cessation from their action; or, to put it in another way, we experience no cessation of work. Our bodily substance is constantly being used up in the acts of living. Suppose we offer to support a man only so long as he does some work or other, we might deem our part of the bargain null and void if he slept or rested. But the idle man, as daily experience proves, must eat and drink, as does the busy individual. The idle being might justifiably enough hold us to our part of the contract, by proving to us what physiology declares to be sober truth, namely, that even during idleness or sleep, the body works. The heart never ceases its work; the lungs and the breathing muscles apparently know no cessation from

their labours; the brain is ever active in some or other of its parts. If we learn that in twenty-four hours a man's heart performs work equal to 124 foot-tons—that is, the total force it expends in its work of twenty-four hours, would raise 124 tons 1 foot high—we may form some adequate idea of the basis on which rests the truth that the idleness of every-day life is not exempt from physiological work of a grave and heavy kind.

An adult human body, in perfect health, is thus seen to lose substance each moment, in the ordinary acts of life. It is clear that there must exist a limit to this loss. Pursued to extreme limits, the body would waste away entirely. We grow thinner after work, and the difference between physiological and well-nigh inappreciable thinness, and that material decrease which becomes visible to the eye, is only one of degree after all. Hence we begin to perceive that the repair of this wear and tear must be as incessantly taking place as is the loss of substance itself. We also see that *food-taking* is the plain means whereby this loss is made food. "Food," is only matter containing the elements of the body in a more or less easily assimilated form, and through which we replace the substances which have disappeared from our bodies in the work which the act of living entails. Hunger and thirst are nature's warnings that the loss must be repaired. They resemble the automatic danger whistle of the engine or the ring of the fire-alarm, which acts as a warning that instant attention is needed to a source of possible danger—this danger in the case of our bodies, existing in the weakness which would ensue from the non-repair of our bodily substance. A healthy man, then, whose outgoings in the way of waste (the result of "work" of one kind or another) equal his incomings in the shape of "food," should neither gain weight nor lose it. As a matter of fact, this issue is borne out by the observation of the body in health. Life, viewed in this aspect, is in reality a kind of bookkeeping by single entry. One column contains the *income*, consisting of food in the shape of air, water, and solids—whereof flesh-forming matter, starch, sugar, fats, and minerals are the chief constituents. The other column contains the *expenditure*, which consists of water, carbonic-acid gas, ammonia, urea, and other matters. A calculation of the physiological "business" would show us that about $8\frac{1}{3}$ lb. of matter are absorbed, whilst about $8\frac{1}{3}$ lb. are given off as waste matter per day, in the healthy adult economy. The *profit* connected with this important transaction, is represented by the *energy* or the *power of doing work* we obtain from our food. It may be interesting to point out that a calculation gives the amount of energy exhibited by an adult man in twenty-four hours as equal to about 3,400 foot tons—a force equal to that required to lift that number of tons one foot high. Of this amount of force, about one-tenth is expended in our varied movements. The residue seems to be occupied in the production of heat. And the amount so expended in "keeping ourselves warm," is represented by power sufficient to raise a man's body (weighing about 150 lb.) to a height of $8\frac{1}{2}$ miles. So we discover that a human body is the seat and origin of an amount of energy which, but for the exact experimentation on which these data have been founded, would almost defy belief.

During the recent storms, the wind-pressure plates erected on the Forth, under the orders of the engineers of the Forth Bridge, have indicated a maximum pressure of 20 lb. per square foot of the smaller plate of 2 square feet, while the large heavy plate of 300 square feet has indicated but 12·5 lb. per square foot.

LECTURING NOTES.

By Richard A. Proctor.

Five courses of lectures for the Gilchrist Trust were commenced by me last week, at Leicester on Monday, at Lincoln on Tuesday, at Chesterfield on Wednesday, at Doncaster on Thursday, and at York on Friday; the remaining lectures will be given in due course, by Dr. W. B. Carpenter, F.R.S., Mr. W. Lant Carpenter, the Rev. Mr. Dallinger, and Professor Martin Duncan. At all the places named there were crowded, attentive, and kindly audiences. At Leicester hundreds were turned away from the Temperance Hall, at Lincoln the large Corn Exchange was filled (about 2,000 were present), at Chesterfield and Doncaster there were similar crowds, and lastly, at York, the bills in the streets announced that no more tickets remained (for course tickets an advance of 400 per cent. on the original price was offered). It is well to see that the bequest of Mr. Gilchrist is thus appreciated.

Although it has been no new experience to me to address most kindly and attentive audiences in this part of England, I must confess it seems to me significant of good, that, with so absurdly low a charge as one penny for admission, no disturbing element should ever be present at these Gilchrist gatherings. That among from a thousand to two thousand auditors there should be apparently not one who has not come to listen for more than an hour attentively to talk about astronomy, or geology, or electricity, is interesting, even in such large cities as Leicester, Lincoln, and York. But that having come, not one should tire of what must be new and strange to many, seems to me still more noteworthy. I must confess that had I seen a score or more filing out towards the end of the lecture, I should have been little surprised; for the only way in which scientific food is at all prepared for readier digestion in these lectures is by the omission of technicalities. The rule assigned to Knowledge is the rule I have ever followed in lecturing,—simply to give "science plainly worded but exactly described." It has ever seemed to me that oratory is out of place on the lecture platform. The truths of science are of themselves so impressive that they need no tricks of eloquence or fine speaking—which, indeed, serve but to obtrude the petty personality of the lecturer between his hearers and the grand teachings of nature. And speaking of the lecturer's personal feelings, I may remark that, in my opinion, the greatest compliment an audience can pay a lecturer on science is to restrain (during the discourse) the applause their goodwill would offer him, that they may the better attend to what he is telling them. Applause at the end comes all the more effectively and pleasantly, though unfortunately, so far as my own subject is concerned, it comes at a time when the lecturer recognises to the full his utter nothingness in relation to what he has been saying. He feels that one might as well applaud the wind for the music of the Æolian harp, as the lecturer for the grandeur of the truths of science.

Engineering and Metal Trades Exhibition.—Under this title, a large and very important exhibition is to be held in the Agricultural Hall, London, from July 5 to the 21st of this year. It will comprise specimens of engineering and mechanical work of almost every kind. Like the highly successful Naval and Submarine Exhibition of last year, the present undertaking is entirely the work of Mr. Samson Barnett, jun. The short time during which the Exhibition will be open is scarcely a drawback—at least from a business point of view, as many of last year's exhibitors can doubtless testify.

MR. SPENCER'S IMPRESSIONS OF AMERICA.

DISCUSSING the conditions and causes of the immense developments of material civilisation, which he has observed in America, developments of which his previous studies had given him no adequate idea, Mr. Herbert Spencer properly gives a prominent place to the inventiveness which has been "so wisely fostered." "Among us in England," he said, "there are many foolish people who, while thinking that a man who toils with his hands has an equitable claim to the product, and, if he has special skill, may rightly have the advantage of it, also hold that if a man toils with his brain, perhaps for years, and uniting genius with perseverance, evolves some valuable invention, the public may rightly claim the benefit. The Americans have been more far-seeing. The enormous museum of patents which I saw at Washington is significant of the attention paid to inventors' claims; and the nation profits immensely from having, in this direction (though not in all others), recognised property in mental products. Beyond question, in respect of mechanical appliances, the Americans are ahead of all nations."

Touching the probable issue of the gigantic social, political, and racial problems in process of evolution in the United States, Mr. Spencer said:—

"No one can form anything more than vague and general conclusions respecting your future. The factors are too numerous, too vast, too far beyond measure in their quantities and intensities. The world has never before seen social phenomena at all comparable with those presented in the United States. A society spreading over enormous tracts, while still preserving its political continuity, is a new thing. This progressive incorporation of vast bodies of immigrants of various bloods has never occurred on such a scale before. Large empires composed of different peoples have, in previous cases, been formed by conquest and annexation. Then your immense plexus of railways and telegraphs tends to consolidate this vast aggregate of States in a way that no such aggregate has ever before been consolidated. And there are many minor co-operating causes unlike those hitherto known. No one can say how it is all going to work out. That there will come hereafter troubles of various kinds, and very grave ones, seems highly probable; but all nations have had, and will have, their troubles. Already you have triumphed over one great trouble, and may reasonably hope to triumph over others. It may, I think, be reasonably held that both because of its size and the heterogeneity of its components, the American nation will be a long time in evolving its ultimate form; but that its ultimate form will be high. One great result is, I think, tolerably clear. From biological truths it is to be inferred that the eventual mixture of the allied varieties of the Aryan race forming the population will produce a more powerful type of man than has hitherto existed, and a type of man more plastic, more adaptable, more capable of undergoing the modifications needful for complete social life. I think that whatever difficulties they may have to surmount, and whatever tribulations they may have to pass through, the Americans may reasonably look forward to a time when they will have produced a civilisation grander than any the world has known."

UNIVERSITY LECTURES.—The London Society for the Extension of University Teaching has just issued its programme of lectures for the ensuing session (January-April). Courses of lectures, accompanied by class teaching, will be given at eighteen different centres in all parts of the London district, from Whitechapel in the east to Bedford Park in the west, and from Stoke Newington in the north to Peckham in the south. The lectures comprise a considerable variety of subjects, such as English history and literature, mediæval art (in the congenial soil of Bedford Park), hygiene, and physical geography. The lecturers are all appointed by a Joint Board of the Universities of Oxford, Cambridge, and London, of which Professor Stuart, of Cambridge, is chairman; and much of the work is done by well-known authorities on their subjects, such as Professor S. R. Gardiner and Professor J. W. Hales. All particulars may be obtained from the Secretary, at 22, Albemarle-street, W.

THE ELECTRIC LIGHT IN THE CITY OF LONDON.—The Select Committee of Commissioners of Sewers on Electric Lighting reported on Tuesday that a licence would in all probability be granted, making it compulsory to supply electric lighting in a small area, and permissive to supply outside that compulsory area, such permissive powers to be reasonably and fairly exercised at the discretion of the Commission. The committee suggested that the Court should apply for a licence for permissive power to supply or contract for the supply to the whole City, and specify certain areas in which the supply should be compulsory, and they recommended that they be empowered to prepare a draft licence framed on the principle of becoming undertakers and of contracting with reliable electric lighting companies for the supply of electric lighting, and they asked authority to negotiate with the companies in respect of the areas in which the supply was proposed to be made compulsory, leaving the other portions of the City to be dealt with more at leisure, as circumstances and the experience gained in respect of the compulsory areas might dictate.

MR. COURTNEY, M.P., ON SCIENCE.—Mr. Courtney, in presiding at the annual meeting of the Royal Cornwall Geological Society at Penzance, referred to the introduction of the electric telegraph and the invention of the steam-engine, by which electricity and steam had been made our slaves in almost all the operations of life. No doubt these were most remarkable applications, and we in the present day were greatly indebted to them; but at the same time he was bound to say that, in his opinion, we might overrate the debt. The conveyance of news by the telegraph was insignificant, if the news itself were not of importance. As to the diminution of toil which steam effected in supplying our wants, it depended very much on the use we made of it, and how far that did or did not confer a benefit on mankind. Was it a fact that, owing to the introduction of steam, the labour which was necessary for the subsistence of the multitude had been in any sense diminished, and the ragged edge of pauperism which surrounded the borders of society had in any sense disappeared? We might derive either of two advantages from the introduction of steam—we might either make life less toilsome while maintaining the mass of it as it was, or keep up the toil of life while increasing the mass, and he was afraid the result of the discovery of steam-power had been an increase in the number of human beings rather than an improvement in the quality of life. He was, indeed, more disposed to reverence science for its educational than for what he might call its economic advantages, for the way in which it elevated the mind of man rather than for its ability to enable more men to live on the same low level on which men lived before; and it was because he believed in geology, and its kindred science, astronomy, as most powerful helps to the elevation of the mind of man, that he was willing to pay his humble respects to those who prosecuted those particular sciences and conveyed to others their blessings. —*Times.*

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THE FACE OF THE SKY.

(*From January 19th to February 2nd*, 1883.)

THE student will maintain his watch on the Solar surface, as recommended on p. 11.

Mercury may be detected with the naked eye on every clear evening, after sunset, glittering above the S.W. by W. point of the horizon. The beginner who may employ a compass to determine this point, must carefully note that the magnetic needle in this country does not point to the true North, but 18° or 19° to the west of it. Venus is still a most conspicuous object in the morning sky. The major part of the constellations spoken of on p. 11 continue to spangle our night sky; but Pisces and Cygnus are disappearing in the west; and Cancer (Vol. I., p. 376) Leo (id) Monoceros, Hydra and Canis Major and Canis Minor (Map Vol. I., p. 383), are now coming well into view in the Eastern half of the sky. Saturn continues stationary (to the naked eye) to the south-east of δ Arietis. Jupiter describes a slightly retrograde path during the fortnight, carrying him from east to west at 1° or 2° above ζ Tauri. To-night (January 19th) his second Satellite will reappear from eclipse at 6h. 41m. 9s. to the right of the planet, and somewhat below his equator (as seen in an inverting telescope). At 8h. 34m. p.m., Satellite I. will enter on to Jupiter's disc, followed by its shadow at 9h. 20m. The Satellite will pass off at 10h. 49m., and its shadow at 11h. 36m. p.m. To-morrow night, the 20th, the same Satellite will be occulted at 5h. 43m.; but instead of emerging from behind the opposite limb of the planet, will plunge into his shadow while still behind Jupiter, and will not reappear from eclipse until 8h. 44m. 5s. p.m. On the 21st, Satellite I. will pass off Jupiter's face at 5h. 16m., as will its shadow at 6h. 5m. p.m. On the night of the 22nd, the observer should direct his attention to the egress of Satellite III. at 6h. 35m., or rather, to the appearance of the Satellite itself, as soon as the evening becomes dark enough, inasmuch as it has been seen on a good many occasions itself as a *dark* spot, like its own shadow. Its real shadow will not enter on to Jupiter's following limb until 7h. 15m. p.m., and will leave the opposite one at 10h. 1m. p.m. On the 24th, too, the student should narrowly watch the transit of Satellite II., which (or rather its shadow) has been seen to present some rather abnormal phenomena. The Satellite will enter on to Jupiter's disc at 9h. 52m. p.m., to be followed by its shadow at 11h. 36m. The egress of the satellite will occur 37 minutes after midnight; that of the shadow at 3h. 54m. a.m. on the 25th. On the 26th, Satellite II. will reappear from eclipse at 9h. 16m. 37s. p.m., and also the same night, the ingress of Satellite I. will occur at 10h. 21m. p.m., and that of its shadow at 11h. 15m. The Satellite will leave the planet at 12h. 36m. p.m.; and the shadow at 1h. 31m. the next morning. On the 27th, Satellite I. will be occulted at 7h. 30m., and reappear from eclipse at 10h. 39m. 33s., p.m. The same Satellite will cross Jupiter's face during the evening of the 28th, the sequence of phenomena being, ingress of Satellite 4h. 48m., p.m.; of shadow, 5h. 44m., p.m. Egress of Satellite, 7h. 3m., p.m.; of shadow, 8h. 0m., p.m. On the succeeding evening the same Satellite will reappear from eclipse at 5h. 8m. 30s. The chief feature of interest, however, on the 29th, will be the transit of Satellite III.; which, for the reason stated above, should be carefully watched. The Satellite enters on to the planet's face at 7h. 25m.; and passes off at 10h. 5m., p.m. Its shadow will actually not enter on to Jupiter's disc until 11h. 15m., or 1h. 10m. after the Satellite casting it has left that disc. It will pass off the preceding limb of the planet at 2h. 2m., a.m., on the 30th. A transit of Satellite II. will begin at the not very convenient hour of 12h. 16m., p.m., on the 30th; its shadow following it at 2h. 14m., a.m., on Feb. 1, and its egress occurring at 3h. 1m.

The Moon is in Taurus on the 19th, passes through a portion of Orion, and into Gemini on the 20th; remains in Gemini during the 21st; passes into Cancer on the 22nd, and travels to the eastern limit of that constellation on the 23rd; is in Leo on the 24th; travels across a portion of Sextans, and into Leo again on the 25th, not quitting it during the 26th. She enters Virgo on the 27th; is there through the whole of the 28th and 29th; moves into Libra on the 30th, and is still there on the 31st and on the 1st of the succeeding month. Her age at noon is 10·3 days on the 19th, 11·3 days on the 20th, and so on, being obviously 23.3 days on February 1. The occultations which occur at convenient hours during one specified period are, unfortunately, all of small stars. To-night (the 19th) BAC, 1651, a 6½ mag. one will disappear at her dark limb at 11 o'clock, at an agle from her vertex of 70°;* and reappear at her bright limb, at an angle of 354°, at 11h. 54m. p.m. On the 20th. 71 Orionis, a 5½ mag. star, will disappear at the dark limb at 9h. 23m. p.m. 2° from the vertex, and reappear at the bright limb at an angle of 330° at 9h. 49m. On the 23rd A^3 Cancri will reappear at the dark limb (now the *western* one) at an angle of 244, at 6h. 3m. p.m. 60 Cancri, another 6 mag. star, will disappear at the moon's bright limb on the same evening, at 9h. 49m., at an angle of 37° from her vertex, and reappear at her dark limb at 11h. 6m. p.m., at an angle of 233°. The remaining two occultations this month occur at hours too inconvenient for the amateur astronomer to involve the necessity of any details being given here.

* See page 11.

"Let Knowledge grow from more to more."—Alfred Tennyson.

Letters to the Editor.

Only a small proportion of Letters received can possibly be inserted. Correspondents must not be offended, therefore, should their letters not appear.

All Editorial communications should be addressed to the Editor of Knowledge; *all Business communications to the* Publishers, *at the Office, 74, Great Queen-street, W.C.* If this is not attended to, delays arise for which the Editor is not responsible.

All Remittances, Cheques, and Post Office Orders should be made payable to Messrs. Wyman & Sons.

The Editor is not responsible for the opinions of correspondents.

No communications are answered by post, even though stamped and directed envelope be enclosed.

THE SUNDIAL OF AHAZ.

[688]—The shiftings of shadows on the dial that Isaiah predicted to sick Hezekiah, are liable to occur at any place, when these two circumstances concur; 1st, that the upper atmosphere is in that condition which causes two bright parhelia or mock suns to appear on opposite sides of the sun; and 2nd, that the lower air contains drifting clouds, massive enough to hide often two of the three. When the real sun and eastern mock sun are hidden, there is only the western to cast shadows, which then coincide with what the sun will cast an hour and a half later; but if the clouds shift so as to hide the west parhelion, and disclose the eastern, the shadows instantly become such as the sun cast an hour and a half earlier. The parhelia being always caused by rays refracted through two faces of equilateral triangular prisms or fibres of ice, their angular distance from the sun is always the minimum deviation that such a prism of ice produces on the brightest or yellow rays, which is very near a fourth of a right angle; so that if Hezekiah's diallers divided the quadrant into forty, than which no number is more likely, considering how constantly it recurs in the Hebrew Laws and History (oftener, indeed, than any other above ten), the advance or recession of the shadow would have to be ten of these parts.

On March 29, 1848, these effects occurred, had anyone been looking, on every dial in the Isle of Portsea, and very probably of much of Hampshire besides. The parhelia were present and bright enough at about 11 p.m., and still better between 1 p.m. and 1.30 p.m. (not between 11 p.m. and 1 p.m., because, though the atmospheric conditions were right, the sun had risen above the required limits of altitude), and the drifting clouds below were present.

By means of Maty's index to the first seventy volumes of the "Philosophical Transactions," I find, between 1668 and 1750, thirteen accounts of similar parhelia that would give these effects if the clouds were present. Six of them were in England, and two described by Halley (rare luck, I should say, for one person to witness two), and of the former, he says (Vol. XXIII., p. 1,128), "it was plain that the vapour which caused this appearance was higher than the clouds, for they were seen to drift under the circles." In Vol. XL., p. 59), Martin Folkes, V.P.R.S., describes and figures another, of which he says that, at one time, "the southern parhelion was so bright that, by taking the advantage of a place where a chimney shaded the true sun, it cast a very visible shadow." Obviously, then, the clouds present in my case and Halley's might have served as well as this chimney.

What Halley calls "the vapour which caused" these appearances, Descartes had proved could be nothing but an atmosphere fibrous, as it were, with ice prisms, such as, when turned at random in all directions, produce the ordinary halo of 45° diameter,

that we often see round the sun or moon. These must, on rare occasions, be polarised, or brought by electrical or some other force into rigorous parallelism, like the atoms of a crystal or magnet, though occupying scores of cubic miles of the upper air. They must all be vertical, to give the astonishing display of circles and spectra that, seen at Rome, March 29, 1629, led Descartes to work out their optical explanation; but which display seems hardly to have been as complete as I had the fortune to see on the corresponding day (a mere coincidence) of 1848. A horizontal white circle, no wider than the sun's disc, passes through him, and through five other suns, all at the same altitude; the two nearest at 22½° from him, say about 25° of azimuth, the others at the azimuths 120° and 180°. These three furthest, properly called *anthelia*, though much the most compact and sunlike, are far too faint to cast any shadow. The two dazzling parhelia are merely spectra, with all the colours, but the middle yellow in such excess as to enable either one to give, if the sun be hidden, the shadows that Hezekiah was shown. Next brightest to these (in my display) were the upper and lower parts of a broken and elliptical halo, of the common sort, but having no lateral parts. Its top and base were rendered so bright by two tangential fragments of similarly-coloured arcs, touching and doubling them. Twice as far as the parhelia, and near the horizon, were two other short pieces, as of common rainbows, convex towards the sun. Then two long arcs, of at least 120°, went over from the sun himself to intersect the white circle at the opposite anthelion; and these were white near the sun, growing more and more edged with colours the farther they went. The white circle was, as Halley says, the most astounding object. Though the sky was (and must be) a paler blue than usual, it backed up the northern parts of this silvery hoop, between the three anthelia, with such relief that I thought birds could perch upon it. An old carpenter was at his door in Portsea, with Ferguson's "Astronomy," or some such book, open at the "armillary sphere," trying to make out what *armillæ* were showing themselves.

In all the thirteen displays recorded in the "Philosophical Transactions," as well as this, the two bright parhelia were right and left of the sun, at the same altitude; but there certainly are cases, well attested, of their being over and under him, vertically or not. These must be much rarer, the polar arrangement of ice fibres being far less likely to be in any other direction than vertical; and I fear the following, which I meant to adduce, will not do. In Lady Strangford's "Egyptian Sepulchres and Syrian Shrines," Ed. 1874, p. 184, on leaving Lebanon, she says, "Our last afternoon at the cedars afforded us the extraordinary sight of what is called, I believe, a false sun: the mist had jammed itself up into dense masses, like a rough sea of ice-pack, filling up and smoothing over the whole valley, and extending over the sea beyond; behind this the sun in due time sank—but, ten minutes after, another sun of flaming blood-colour arose, and after shining with an awful kind of dark brilliancy for about a quarter-of-an-hour, it also faded away and died behind the mist clouds—very marvellous it was altogether." The puzzle here is in the word "also," which led me to associate the two suns as disappearing the same way, and the "flaming blood colour" would apply to a prismatic parhelion, red at the base and flaming above. But the words "arose" and "fade away," instead of set, now make me suspect it was an anthelion in the East. Somebody may say it throws a light on Joshua's famous sun miracle; but I was fully convinced long ago by Jacob Bryant that this had nothing to do with the natural sky, and the two verses from Jasher have no more business in the Book of Joshua than have the son of Sirach's wise remark, that "one day was as long as two." The Old Testament revisers, we may hope, will banish them and translate Joshua's speech accurately, "Sun of Gibeon be thou silent, and thou Moon of Arajalon." This sun and this moon were, like Apollo of Delphi, false gods, but real beings, who received worship and gave oracles in two temples, which two alone, of all the temples in Palestine, the Hebrews could not destroy, as they had been commanded because of the perpetual treaty into which the Gibeonites had inveigled them. Hence the only possible way of ending the Gibeonite religion was by silencing their gods, which Joshua was that day commissioned to do by those words, as miraculous as when, ages later, Apollo of Delphi and the rest were as suddenly silenced at the advent of the great real Joshua. He is not recorded as saying a word about standing still; and if the day had been any longer than usual, would any chronicler dream of writing this after the statement that the enemy fled, but were destroyed in the night by a hailstorm? Again, would New Testament writers, especially he who wrote to the Hebrews, chap. xi., utterly ignore such a stupendous fruit of faith?

Physical science can have no more bearing on Joshua's miracle, which was a purely metaphysical one, than on Christ's saying to people, "Thou hast had five husbands," or "There shall meet you a man bearing a pitcher of water." But, returning to Hezekiah, considering how much steeper is the sun's daily path in the latitude of Jerusalem than in England, it seems more likely that the pair of parhelia were of the rarer kind, over and under the sun, which I certainly have seen described (or possibly even oblique), than the commoner ones that I saw, and Descartes, Halley, Folkes, and the other Royal Society observers. From the account in Isaiah, speaking of bringing back the sun, but the fuller one in Kings of only bringing back the shadow, I gather the Book of Kings to be the earlier document, and more likely, in this place, to preserve that prophet's own words.

The same book has, in Chapter III., an account of another optical phenomenon that I once thought very incredible. Captain Burton derided it, when comparing this chapter with the Moabite Stone, which he thought more genuine. The story is in verses 22 and 23. Now it happened that one morning, near the winter solstice, I started by an early train from London for the south-west, and was looking from its S.E. side when it entered on the water meadows of either the Mole or Wey. Suddenly I was startled, as well as the opposite passenger, by looking down on what seemed a round pool of blood, two yards in diameter. The next minute we came to so many pools or channels, tinged not quite so deeply, that we remarked some new chemical factory or dye-works must be making all this sanguinary appearance. We had hardly said this, when a mile or more of the main stream came into view, with the sun rising red beyond it. In another hour there was violent wind and rain, and the day about the stormiest I ever saw; but I could never again deny that I had made exactly the same mistake as the Moabites.

E. L. GARBETT.

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[689]—While reading Mr. Garbett's tantalising letter on "The Dial of Ahaz," a possible solution of the problem suggested itself to me. Let us suppose a great display of solar haloes with well-developed parhelia, &c., to be visible; then if a dark cloud were to float across the "mock suns" and the true solar disc, in due succession, it seems to me that the required conditions would be fulfilled.

I remember, when a child, during a solitary ramble, looking up and suddenly seeing the phenomenon I have alluded to (minus the cloud) in all its awful grandeur, and I shall never forget the shock of terror I experienced. F.G.S.

[Well hit.—R. P.]

A LOGICAL PUZZLE.

[690]—Your logical puzzle reminds me of another I heard at a friend's house some years ago, that several friends assembled there on that evening could not see:—(1.) There are more cows in the world than there are hairs in any one cow's tail; therefore (2) There are at least two cows in the world with exactly the same number of hairs in their tails. AN ORIGINAL SUBSCRIBER.

[A capital puzzle; certainly more in it than in the logical puzzle—at least in De Morgan's ingenious illustrative case. The fallacy in this should not mislead for an instant, but it takes a clear head to see within ten or twenty seconds that there must be at least *two* cows with the same number of hairs in their tails, if there are more cows than there are hairs in any *one* cow's tail, *unless* (which our correspondent omits to notice) *one of the cows has no hairs at all on her tail*. For instance, there might, in accordance with the conditions, be three cows in the world, one with no hairs, one with a single hair, and one with two hairs, on tail.—R. P.]

SPRINGS AND STREAMS.

[691]—(1) Why do springs and streams rise during the prevalence of an east wind? (This is said by the millers in Dorsetshire to be an invariable rule.)

(2) Why may we expect rain when the springs go back suddenly?

(3) Why after the heavy rains we have had lately are the springs still going back? Is this dependent on local causes? ZETA.

FELLOWSHIP OF LEARNED SOCIETIES.

[692]—I am very glad to see the note (No. 674), by an F.R.A.S., upon Fellowships of Learned Societies. It is very desirable that as many people as possible should join and support these societies either for pleasure or as students; but why should they not be styled "members"? Let "fellowship" be only conferred, as your correspondent suggests, upon those who are more or less past

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masters in their respective sciences. The imposing letters will then be understood as a real ornament to a man's name. H. B. L.

[The difficulty is that men have usually to become candidates of their own will. This prevents many from even acceding to the request that they should consent to be nominated. They object to being confounded with those who, after long hankering, have got in.—R. P.]

Answers to Correspondents.

W. JOHNSTON. It would not do for me to advise. I know nothing of the system. But I may remark that the advertiser has offered me full opportunities of testing it.—W. G. R. (1) There have been many references to the magnificent comet of 1858 (Donati's), but not in KNOWLEDGE, because a full account of that comet (with pictures) was given in early numbers before the recent comet appeared. (2) Halley's Comet returned in 1835, and will not be seen again before 1910; but there were some who expected a return of the comet of 1256 at about that time.—BERNARD BATEGEN. That "God rest you merry" matter is not one about which there is any diversity of opinion. It is not a Shakespearean expression, but is found in hundreds of places, in various forms, "God rest you fair, "God rest you happy," &c., &c., &c.—PHILIP S. PARKES. Fear can give no information about Railway Signal Engineering. —P. The theory is quite inconsistent with the observed appearance of comet's tails.—L. L. M. The misprint Q, for K, had seemed too obvious to be noted among errata. It is very good of you to speak of the mistake as startling, because that implies few mistakes and far between. As to the pundit's objections to whist, I fully share your feeling. People view things so differently. One man thinks it well to relax over whist or chess at certain hours (when perhaps he could do little good work), another counts the hour or so passed that way as lost; yet—J. CLAXTON and L. M. N.—this last will consider it a solemn duty to lose as well from relaxation as from work each seventh day, while the other regards the customary observance of the (or a) seventh day as a theft from God's great gift of time. So oddly do men view things! If, however, you (I am no longer answering L. L. M.) would but keep clear of denunciation, and recognise that what one deems wrong another may regard as a duty, all would be well. Only it is so much easier to look into your neighbour's potato-patch than to work in your own. Now, for my own part, I have a very tender conscience in the matter of work, yet I often, and as a duty, hearken to what Mr. Spencer calls the Gospel of Relaxation; but, on the other hand, were I to waste a seventh part of my time, my soul would cry foul shame on me. Yet, I remember hearing it said, at a great gathering of the over-paling-at-neighbours-peering community, that to do what I have done for twenty years, as a *duty*, is as bad as it would be "to stab a friend under the fifth rib" (I do not know why rib, nor why fifth). So do men differ, as I said. Yet, as men who think like me do not rebuke you, who hide in a napkin one seventh part of the great talent, *Time*, it seems rather odd to be denounced so roundly about your foolish fetish. It was natural enough, perhaps, that those Eastern writers who pictured a Deity after the fashion of one of their own despotic rulers, should be unable to rise to the conception of Infinite Power, needing no rest and refreshment, but "working hitherto" as one wiser than they said, and working hereafter, for ever. When nature stops working every seventh day, come and tell us that the God of Nature wishes us to do likewise. We may then believe you. You will say I break my own rule in writing about religion. You break the rule, but I do not. For to me there is nothing religious in the question, any more than in wearing a good suit on Sunday or eating mince-pies at Christmas. One doctrine, however, I would particularly indicate to you—to wit, the saving faith involved in the words, "Mind your own affairs." So far as I can judge from your letters, you will want for them all you know. (Without wishing to be dogmatic, may I suggest that you should rather write "separate" than "seperate," and "individual" than "individial.")—F.R.G.S. How can a vertical cylindrical pipe be 60 feet in diameter at top and 18 feet at bottom? In any case, the outflow would have to be determined, probably, by experiment; for the outflowing stream narrows a little below the place of exit, and the amount of narrowing has to be determined by observation. —TIBA. Will be duly answered in our fortnightly "Face of the Sky."—F. ADELINE HARKER. I scarcely cling to that or any tradition. The whole story seems mythical; but doubtless the difficulty you note must be regarded as *raison de plus*.—A. FRANCIS. To give advice, under the circumstances, would be dangerous and wrong.—W. WRIGHT. Cannot always give the questions; do when I can.—J. M. NIXSON. Many thanks about Star in the East. On the other point quite agree with you.—M. Y. What can one do with such accounts? One must quote as given, leaving absurdities to speak for themselves.—A. J. MAAS. Will note your suggestion, but the bilingual testaments are not like the Hamiltonian translations.—F. M. COTTON. Know of no diagrams of comets suitable for lectures, except lantern slides. (York's, for instance). Book information about comets is rather widely scattered. In Sir J. Herschel's "Familiar Lectures" there is a very interesting essay about them. —F. J. LAING. It was Jupiter you so saw.—KERRY RIX. So many subjects wanting room.—H. L. Thanks; tail constantly being formed, never restored to head.—H. B. (1) On any theory whatever, the smallest fixed star must be a very large orb in reality. (2) I was speaking of angular motion only, which is the same for the minute hand of the Big Ben clock as for that of a lady's locket watch.—E. HEWSON. Thanks.—J. SMILES. Your friend is emphatically wrong. Many imagine, however, as he seems to do, that dynamo machines are merely large frictional machines. — G. MERNARD. Thanks; but cannot find space.—T. F. D. Moon could not be so seen in Palestine. — A. KITSON. Examine vertebræ of the next fish you carve—then of a rabbit. Probably those who speak of dovetailed vertebræ do not know what dovetailing means.—A. R. PANNETT. If Cassell's "Concise Cyclopædia" says that the smallest number of eclipses which can occur in a year is four, then is that Cyclopœdia more concise than correct. Smallest number is two, in which case both are solar.—BARTEN FLETCHER. A quaint idea. Would like to see "An Observer's" face as he reads of it,—as you justly say "No one could even *think* of an angel in a corset;" albeit in Pugin's small Catholic Church in Clapham there are angels with "braces" (real good ones,—apparently three-and-sixpenny braces) outside their flowing draperies.—JAS. L. CROWLEY. The star you saw was, no doubt, Venus. It was in about her place.—W. H. K. SOAMES notes that he saw Venus at 9 h. 19 m. A.M. on the 6th, also on December 22 at 8.30 A.M.—UNCLE SAMMY. So sorry you have been bewildered over the logical puzzle, the pride of De Morgan's heart. This is where you have gone wrong in your three instances:—In all three, you start with a premiss which cannot but lead you to a truism, and you get your truism. Thus in one you begin: For every man there is a woman who is not married. You might as well begin: For every Z there is an X, which is not Z, as well as not Y, and be surprised to get out nothing more instructive than the repetition, or rather the quantification, of part of your first premiss. So with the others, where you begin: "For every drunkard there is a moderate drinker," &c., and "For every white man there is a coloured man," &c. If your first premiss, of its very nature, signifies that *none* of the X's are Z's, you must not be astonished if the conclusion that *some* X's are not Z's should seem scarcely worth reasoning about. In all reasoning the rule should be *Respice finem;* don't try to prove about *one* or *some* what you already know about *all*. You can make equal nothingness out of the simpler syllogisms as out of one of these quantification syllogisms. Thus, no coloured man is a white man; Kalekaua is a coloured man; therefore Kalekaua is not a white man.—PSYCHOMANTIS. Comets move in ellipses of very different eccentricities and dimensions. Last great comet moved in a plane inclined about 36° to plane of earth's orbit. Why should *not* a comet be seen both from England and Australia? The constellation Orion can be seen from both countries; so can the planets.—F. S. L. Surely an Archbishop should be innocuous. Is there disparagement in the word? Or in neutral? Would you substitute "offensively onesided." You put "quotes" to "Tait," perhaps deeming my use of the name without the title offensive. But I had no such idea. The "innocuously neutral late Right Reverend Doctor Tait, Lord Archbishop of Canterbury" would have read rather heavily: *voilà tout*.—W. L. ROGERS. Horrocks had a genius for astronomical research; outside of science, judging from his high-flown tone, he was, one would say, rather younger than his age.—JOHN GREENFIELD. Pardon me, Laplace proved nothing of the sort. He showed that with all the planets going the same way round, the system was safe from destructive change; not that it would undergo such change if one or other of the planets had gone the wrong way round. The question is quantitative, not qualitative. If Laplace had proved that no matter what the scale of such a system, or what the masses of the several bodies circling round the sun, any one body going round the wrong way would eventually cause the system's destruction, things would have looked bad for the system; for we know, what he did not, that there are multitudes of bodies going the wrong way round. You seem angry with me for having several times had to correct mistaken ideas of yours. But I did not cause you to fall into those errors. Why, then, should you be angry with *me*? Look nearer home.—C. R. ROWE. No; I lived near Devonport in 1864-66; but kept no school there, or anywhere else.

Our Mathematical Column.

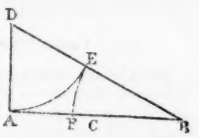
NOTES ON EUCLID.—No. III.

BY RICHARD A. PROCTOR.

(*Continued from page 29.*)

PROPOSITION XI.—PROBLEM. *Let A B be any straight line; it is required to divide A B into two parts, so that the rect. by the whole and one part shall be equal to the square of the other.*

Bisect A B in C, and from A draw A D perp. to A B, and = A C. Join B D. With D as centre describe circular arc A E cutting D B in E, and with B as centre describe circular arc E F cutting B A in F. Then shall the rectangle A B, A F, be equal to the sq. on B F.



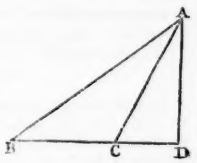
For sq. on D A + sq. on A B = sq. on D B = sq. on D E + sq, on E B + 2 rect. D E, E B.

∴ sq. on A B = sq. on F B + 2 rect. A C, F B
(∵ D E = A D = A C, and B E = B F).

That is, rect. A B, A F + rect. A B, F B = sq. on F B + rect. A B, F B.
∴ rect. A B, A F = sq. on F B.

PROPOSITION XII. *Let A B C be an obtuse-angled triangle, A C B being the obtuse angle, and from A let A D be drawn perp. to B C produced; then the sq. on A B is equal to the sqs. on B C, C A, together with twice the rect. B C, C D.*

Sq. on A B = sq. on A D + sq. on B D
= sq. on A D + sq. on C D
+ sq. on B C + 2 rect. B C, C D.
= sq. on A C + sq. on B C
+ 2 rect. B C, C D



PROPOSITION XIII. *Let A B C be a triangle having angle B acute, and draw A D perp. to B C, one of the sides containing the acute angle: then the sqs. on A B, B C are together equal to the sq. on A C, with twice the rect. B D, B C.*

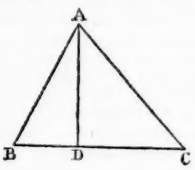


Fig. 1.

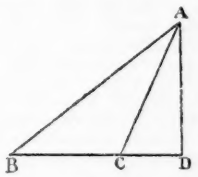


Fig. 2.

First, let D fall between B and C (Fig. 1.).
Then sq. on A B = sq. on A D + sq. on B D
sq. on B C = sq. on D C + sq. on B D + 2 rect. B D, D C
∴ sq. on A B + sq. on B C = sq. on A D + sq. on D C + 2 sq. on B D + 2 rect. B C, D C
= sq. on A C + 2 rect. B D, B C.

Next, let D fall on B C produced (Fig. 2.). Then
Sq. on A B = sq. on A D + sq. on B D
= sq. on A D + sq. on D C + sq. on B C + 2 rect. B C, C D.
∴ sq. on A B + sq. on B C = sq. on A C + 2 sq. on B C + 2 rect. B C, C D.
= sq. on A C + 2 rect. B C, B D.

Last, the case in which D coincides with C needs no demonstration, and has no interest, being to all intents identical with Prop. 47, Book I.

PROPOSITION XIV. *To describe a square that shall be equal to a given rectilinear figure.*

This proposition cannot be more briefly dealt with, at this place, than as Euclid treats it. But it is not really wanted till after properties have been established in Book III. by which the demonstration may be shortened.

Our Whist Column.

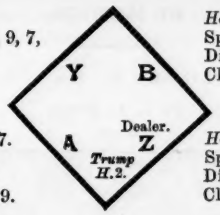
BY "FIVE OF CLUBS."

"REVOKE" points out, correctly, that tricks 12 and 13 of the game at p. 15, the Nine of Diamonds and the Ten of Clubs have been inadvertently interchanged.

THE HANDS.

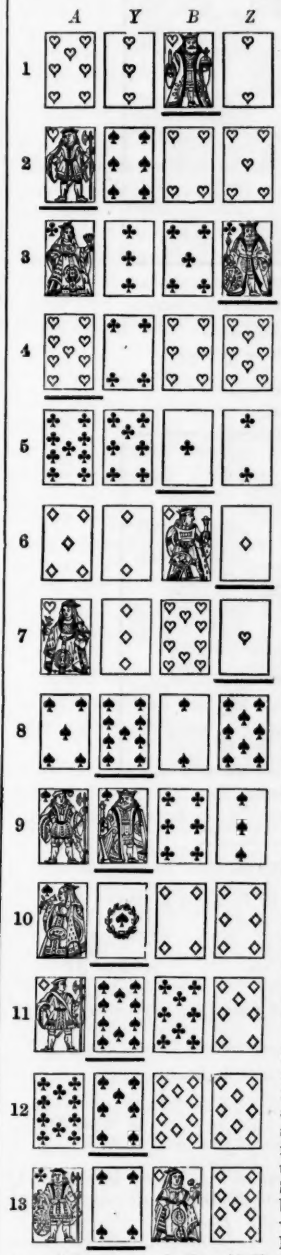
Y.
Hearts—3.
Spades—A, K, 10, 9, 7, 6, 4.
Diamonds—3, 2.
Clubs—7, 4, 3.

B.
Hearts—K, 10, 6, 4.
Spades—2.
Diamonds—K, Q, 10, 4.
Clubs—A, 8, 6, 5.



A.
Hearts—Q, Kn, 9, 7.
Spades—Q, Kn, 5.
Diamonds—Kn, 5.
Clubs—Q, Kn, 10, 9.

Z.
Hearts—A, 8, 5, 2.
Spades—8, 3.
Diamonds—A, 9, 8, 7, 6.
Clubs—K, 2.



PLAYING TO THE SCORE.

THE PLAY.

Score :— { *A, B,* = 3 / *Y, Z,* = 2

NOTE.—The card underlined wins the trick, and card below leads next round.

1. *A* plays as if at the score "love all." If his partner has an honour (and the odds are in favour of *B*'s having one honour at least), *A B* only want five tricks to win. A defensive, rather than a forward game, is therefore indicated.

2. *B* cannot tell whether *A* has led from strength or length in Hearts. But *Z*'s play of the Five shows *A* had not led from five Hearts. The presumption, as *Y* renounces, is that *A* had four Hearts, two honours. *Y*, regarding strength in trumps as declared against his side, discards the penultimate of his long suit.

3. *A* is wise, but not in time.

4. *Z* draws two for one, keeping up the Ace, as he has only one other card of re-entry, and *A* is presumably strong in plain suits. The Queen, Ten, and Nine of trumps being all unplayed, *Z* knows he can gain nothing by leading Ace. *Y* seeing *Z* is not without trump strength, and noting, too, that their case is almost hopeless unless he can bring in his Spades, discards now from *A*'s suit—not from Diamonds, as he cannot tell whether he may not have to lead them to *A* more than once.

5. *A B* make their fourth trick; *Y Z* must now make all the rest to save game.

6. *B* throws away the game, through sheer inattention (to the score and play both). He knows *A* has the winning Clubs, and that *Z* has but one trump left, for *A* could not have led trump Seven from Queen, Knave, Seven only.

7. *Z* of course draws the remaining trumps, and leads his best card in his partner's suit. *Y* makes a deep finesse; not so deep as it looks though, for *A*, having shown no strength in Diamonds, is almost certain, since he led trumps, to hold Queen, Knave in Spades. Apart from this, it would be a question of probability, viz., whether it is more likely that *B* holds Knave or Queen, in which case *A B* win, or whether, if *Y* plays King, the Ace will draw both Queen and Knave, and unless this happen *A B* win equally. The finesse comes off, and

10, 11, 12, 13. *Y Z* make the remaining tricks and win.

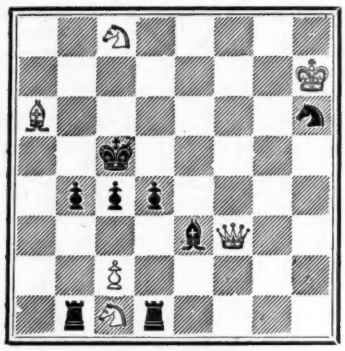
Our Chess Column.

By MEPHISTO.

PROBLEM No. 70.

By J. A. MILES.

BLACK.



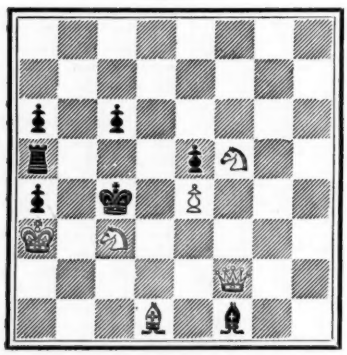
WHITE.

White to play and mate in three moves.

PROBLEM No. 71.

By C. PLANCK.

BLACK.



WHITE.

White to play and mate in two moves.

SOLUTIONS.

PROBLEM No. 66, BY L. P. REES, p. 488.

1.	R to KB3			
	P takes R	K takes R		Kt to KB5
2.	B to R3 (ch)	Q to B6 (ch)		R takes QP
	K moves	K takes Q		Anything
3.	Q to KB5 mate	B to Kt5 mate		Q mates

PROBLEM No. 67, BY FRANCIS J. DRAKE, p. 16.

(*a*) 1. Kt to B6 K to B4

2. Kt tks KP (ch)	K to K4		K takes P
3. P to B4 (ch)	K takes P	P to Q8 (Kt) (ch)	K to K4
4. P to Q8 (Kt) mate		P to B4 mate	

If 2. K to Kt5. 3. B to B2, anything. 4. B to Q sq. mate. If Black plays 1. P moves, or 1. K to B6, then 2. Kt takes QP, and 3. P to B3 mate.

(*b*) 1. B to R2 K to B4 K to B6

2. B to Q5	K to K4 (best)	B to Q5 (ch)	K to Kt5
3. B to K4	P to Q4	B to K4	Anything
4. P to B4 (ch)	K to Q3	P to B3 mate	

5. R to B6 mate.

No. 68, BY W. JAY N. BROWN, p. 16.

1. Q to KR sq.

If 1. K to B5, Q5, or K5. 2. R to Kt4 mate.
If 1. K to B3, Q3, or K3. 2. R to B6 mate.

No. 69.

1. R to Kt7.

If 1. K to K3. 2. Kt to B7 mate. 1. K to K5. 2. Kt to B3 mate.
1. K to B3. 2. Kt to R7 mate. 1. K to B5. 2. Kt to R3 mate.

CHESS PUZZLE, BY F. C. COLLINS, p. 488.

Black's last move was from K5 to Q4. This came about in the following manner:—When the King was on K5 White's Pawn was on White's Kings 5th, and a Black Pawn on KB2. Black being in check with the Bishop, plays P to B4 to cover it, whereupon White plays, P takes P in passing, discovering double check; the King then moved to Q4.

ANSWERS TO CORRESPONDENTS.

*** *Please address Chess Editor.*

South Acton.—Black's twenty-first move in the game on p. 501 is K to B5. He obviously cannot go to B4, on account of the Queen on R3; then follows 22. Q to Kt3 (ch), K to B5. 23. R to K5 mate.

Correct solutions received.—Problem No. 67, R. J. P., John Lonsdale. Nos. 68 and 69, Tyro, W. R. Edwards, F. S. L. No. 69, T. T. Dorrington.

IT will be remembered that the Zoological Society sold Jumbo to Mr. Barnum under the impression that the animal was likely to develop a violent temper. This apprehension has been realised. Jumbo, who is at present at Bridgeport, Connecticut (the winter quarters of Mr. Barnum's menagerie), recently forced his way out of the side of the compartment in which he was located, crashing his way through the planked and spiked structure as though it were paper. It appears that the elephant has more than once been in what is called "his tantrums." On one occasion Scott, the English trainer, who still looks after Jumbo, narrowly escaped injury. The animal made an attack upon a compartment in which his keeper sleeps at night, "crunching up the division like a lucifer matchbox," and making a lunge with his tusks perilously near the spot where Scott was lying. For these breaches of discipline Jumbo was punished. Having his hind feet hobbled, he was, with the assistance of two other elephants in the collection, compelled to kneel down, when he was severely thrashed. Jumbo has since, it is said, "been on his good behaviour." Perhaps it is well that the great proboscidian was not kept at the Zoological Gardens, for serious results might have attended an outbreak of bad temper in the popular resort where he was so long a leading attraction.

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